



Sacramento
and
San Joaquin
River Basins

Comprehensive Study

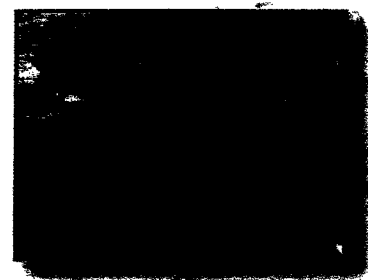
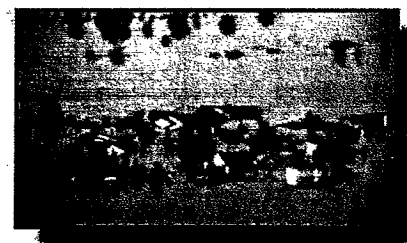
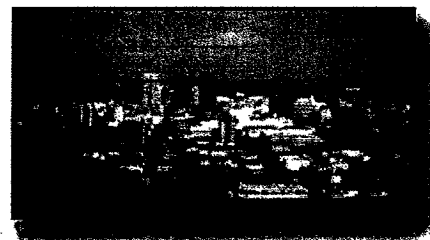
INTERIM REPORT

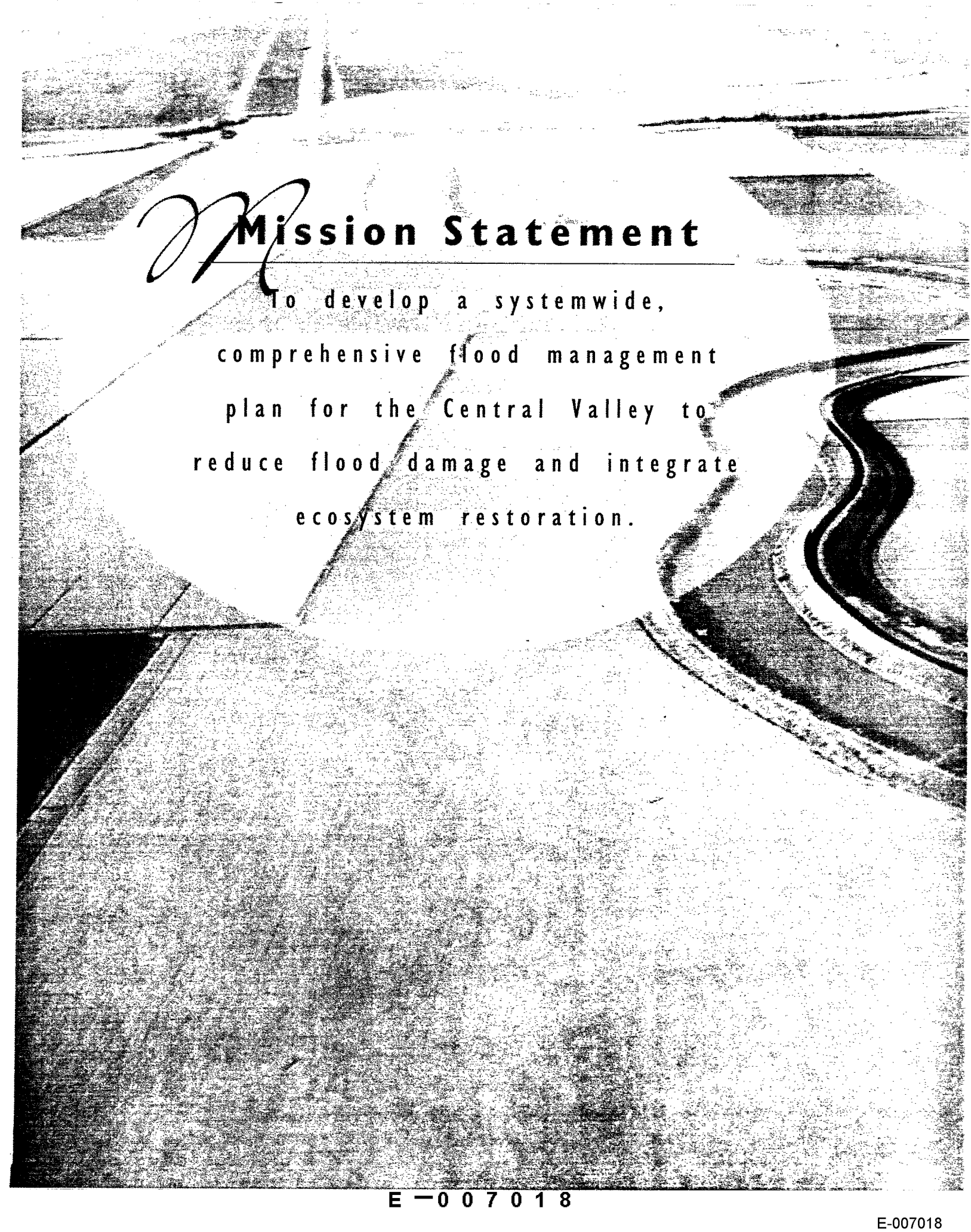
□ Stockton

○ Modesto

*U.S. Army Corps of Engineers, Sacramento District
The Reclamation Board of the State of California*

March 1999



An aerial photograph of a winding river in a valley, with the river curving from the top right towards the bottom right. The surrounding landscape is a mix of fields and some structures.

*M*ission Statement

To develop a systemwide,
comprehensive flood management
plan for the Central Valley to
reduce flood damage and integrate
ecosystem restoration.

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Overview

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Since the mid-1800s, California has enjoyed great economic prosperity. Much of this prosperity has derived from the productive lands and urban centers of the Central Valley. Today, these areas are at risk from flood management systems that no longer meet the needs of this important region. Recent floods have highlighted the extent and magnitude of this problem throughout both the Sacramento and San Joaquin River basins.

The January 1997 flood was one of several large floods to impact the Central Valley of California over the last two decades. The fiscal and emotional impacts of recent floods, together with changes in public attitudes and advances in scientific knowledge have led to the need for a comprehensive evaluation of the existing flood management systems. Recent floods have raised questions about the adequacy of the existing flood management systems and land use in the floodplains. At the same time, public attitudes now include a greater appreciation for environmental conditions and natural features.

Catastrophic damages were narrowly avoided in major floods of 1997 and 1986. Both of these floods pushed the existing flood management systems beyond their limits, resulting in numerous system failures. In summary,

- Existing flood management systems functioned, but were clearly overtaxed
- Combined damages from four recent floods exceed \$1.6 billion
- Another flood like 1986 or 1997 would likely result in similar or greater devastation
- Storms greater than those of January 1997 are possible, and the resulting flooding could be catastrophic
- The flood management systems are in desperate need of upgrade and modification

Recent Flooding Has Raised Concerns About the Existing Systems

In January 1997, Californians experienced one of the most costly and geographically extensive flood disasters in the State's history. Major storms throughout California caused record flows on many rivers. In the Central Valley, the flood management systems for the Sacramento and San Joaquin Rivers were stressed to capacity and beyond. Reservoir flood storage reduced floodflows by 50 percent or more, saving lives and significantly reducing property damage. However, in some areas, levees failed. Levees on the Sacramento River and its tributaries sustained two major breaks. Many levees that did not fail were severely damaged and required extensive repairs. On the San Joaquin River, levees failed in more than two dozen places.

THE COMPREHENSIVE STUDY

In response to extensive flooding and damages experienced in 1997, the United States Congress authorized the U.S. Army Corps of Engineers to provide a comprehensive analysis of the Sacramento and San Joaquin River basin flood management systems and to partner with the State of California to develop master plans for flood management into the next century. The Corps and The Reclamation Board of The State of California are leading a Comprehensive Study to improve flood management and integrate ecosystem restoration in the Sacramento and San Joaquin River basins.

The Comprehensive Study will develop and begin to implement master plans that will increase flood protection and improve the ecosystem on major rivers and tributaries in the Central Valley. Because this study is the first system-wide evaluation of the flood management systems in the Central Valley, it represents a change in how projects are identified, selected, and implemented.

While several local studies and programs address water supply, water quality, and ecosystem restoration in the Central Valley, the Comprehensive Study is unique. The Comprehensive Study is the only project to address regional flood management issues and develop master plans to incorporate both flood damage reduction and river corridor ecosystem restoration in the Sacramento and San Joaquin River basins. Past and current efforts to address these issues form the starting point for the Comprehensive Study.

What makes this study different is its focus on forming a truly system-wide flood management solution with integrated ecosystem restoration while recognizing the importance of early implementation of key projects that will have an immediate benefit to local residents.

The Comprehensive Study is being conducted in two phases

Phase I of the Comprehensive Study focused on evaluating current conditions through a Post Flood Assessment, developing hydrologic and hydraulic models, establishing a mission statement, identifying flooding and related environmental problems, formulating preliminary planning objectives, initiating a public involvement program, collecting potential solution measures, and developing a plan of action for Phase II.

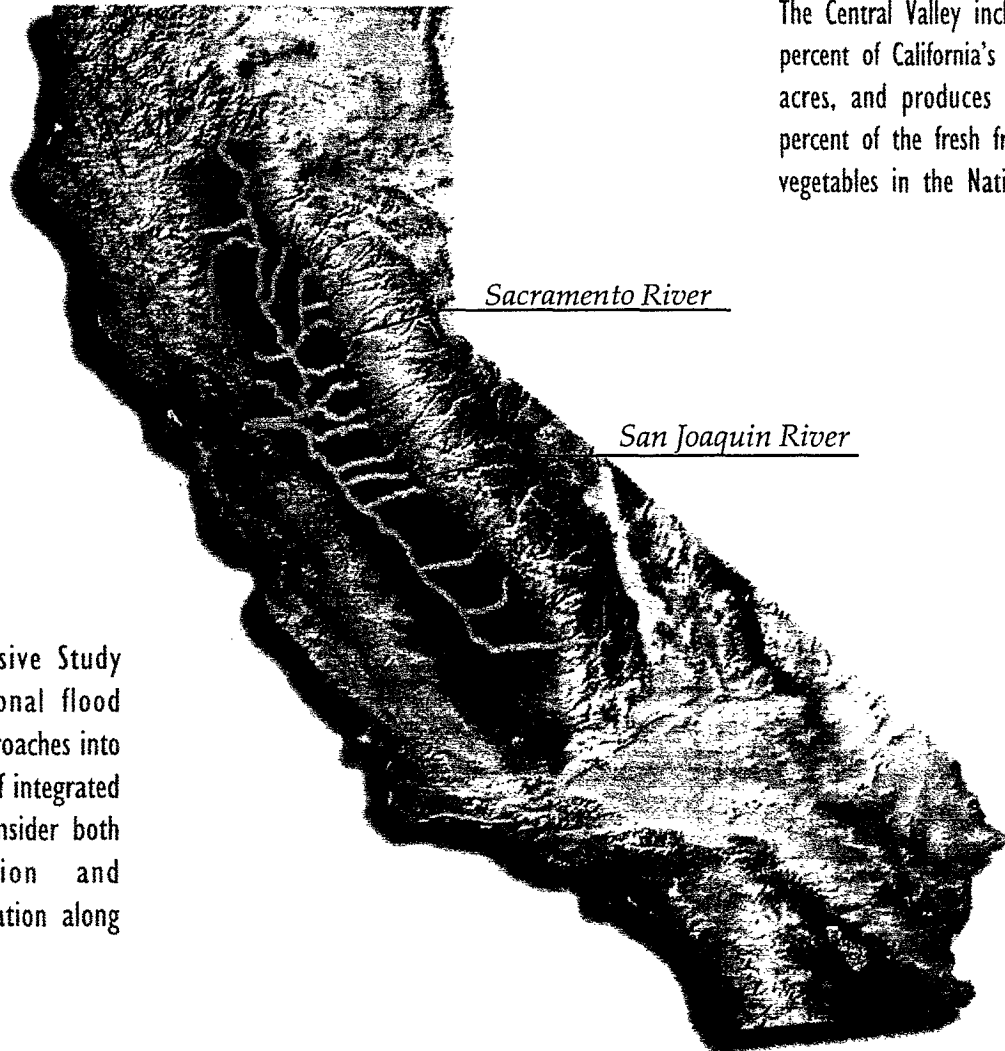
Phase II will concentrate on fully implementing the public involvement program, conducting feasibility-level assessments, developing basin master plans and developing a programmatic environmental impact statement/environmental impact report (EIS/EIR) to support implementation. The final report of the Comprehensive Study will be a programmatic document that includes a recommendation for programmatic authorization of the master plans.

A staged approach to implement the master plans will maintain the integrity of the flood management systems and the participation of local sponsors. Some projects will be recommended for immediate authorization and other priority elements will be recommended for immediate follow-on development. Remaining elements will be implemented as proponents are identified and funds are made available.

BACKGROUND

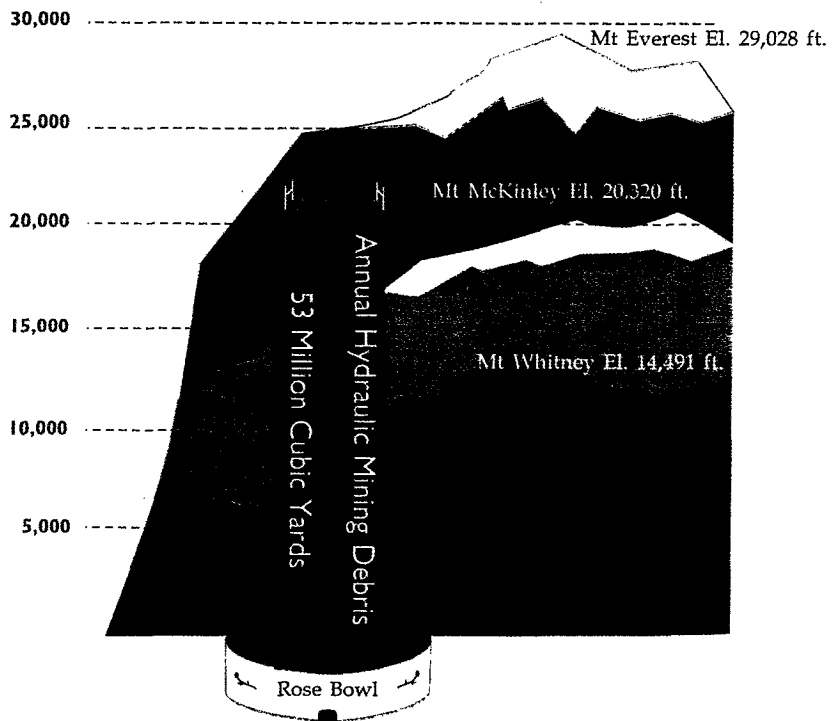
The Central Valley of California contains the two largest rivers in the State, the **Sacramento River** in the north and the **San Joaquin River** in the south. These river systems comprise a combined drainage area of over 43,000 square miles, an area nearly comparable to that of the state of Florida. Due to its climate and geography, flooding is a frequent and natural event in the Central Valley. Historically, the Sacramento River basin has been subject to floods that result from winter and spring rainfall as well as combined rainfall and snowmelt. The San Joaquin River basin has been subject to floods that result from both rainfall that occurs during late fall and winter months, and unseasonable and rapid melting of the winter snowpack during the spring and early summer months.

The Central Valley includes 80 percent of California's irrigated acres, and produces over 45 percent of the fresh fruits and vegetables in the Nation.



The Comprehensive Study extends traditional flood management approaches into a broader array of integrated solutions that consider both flood protection and ecosystem restoration along the river systems.

The discovery of gold in the Sierra Nevada Foothills in 1848 marked the beginning of the California Gold Rush, which brought two important developments that shaped flood management in the Central Valley. First, aggressive mining techniques, particularly hydraulic mining of gold in the Sierra Nevada, caused sediment to deposit in rivers and streams tributary to the Sacramento and San Joaquin Rivers. Vast amounts of material reduced downstream channel capacity, resulting in increased flooding of lower lying areas. Second, with the great influx of people into the State, the demand for goods grew tremendously, prompting agricultural development of the fertile tule lands along Central Valley rivers.



In the late 1800's annual debris from hydraulic mining would cover a football field about 4 miles deep.

Flood management systems in the Sacramento and San Joaquin River basins were

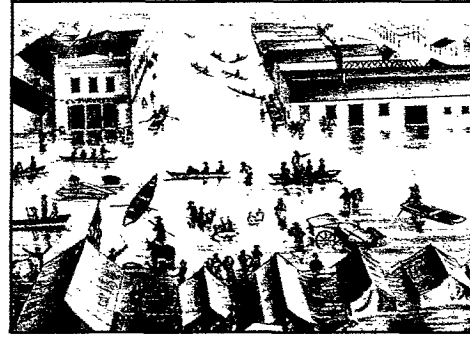
developed incrementally over many years in response to major floods. Between 1850 to 1900, the Sacramento River basin was affected by 12 major floods and the San Joaquin River basin experienced 16 major floods. During that period, flood protection focused on local concerns, and primarily consisted of building or raising levees as landowners protected their lands from the increasingly common floods caused by the influx of mining debris. This work, however, was not coordinated on a regional or system-wide basis and often resulted in conflicting solutions.

Following major flood events in 1907 and 1909, plans were laid for more regional flood management systems. The **Jackson Report**, compiled by the California Debris Commission, proposed the construction of the Sacramento River Flood Control Project. Thus began the coordinated construction of many levees, weirs, and bypasses in the



"Hydraulic mining washed mountains of sediment into the river systems each year"

Sacramento Valley, including levees on the Sacramento, Feather, Yuba, Bear, and American Rivers; and overflow areas in the Butte Basin, Sutter, and Yolo Bypasses. The Lower San Joaquin River and Tributaries Project, authorized in 1944, included the construction of levees on the San Joaquin River downstream from the Merced River. Upstream of the Merced River, the State of California constructed bypasses to protect lands adjacent to the San Joaquin River.



Flooding in downtown Sacramento

Starting in the 1940's, multipurpose dams and reservoirs that provide storage for flood protection, water supply, hydroelectric power generation, environmental requirements, and recreation were constructed on major rivers in the Sacramento and San Joaquin River basins. Some of the multipurpose dams were constructed as part of the **Federal Central Valley Project** and the **California State Water Project**, while others were constructed and operated by the Corps of Engineers, or numerous local entities. The current flood management systems in the Sacramento and San Joaquin River basins reflect the incremental development of flood protection projects, and require extensive coordination among several agencies to operate and maintain.

Between 1900 and 1997, the Sacramento and San Joaquin River basins experienced 13 destructive floods. Four most recent floods – in 1983, 1986, 1995, and 1997 – caused extensive damages in both basins and raised questions about the adequacy of the current flood management systems and land uses in floodplains.

Changing Views About Floodplains

Scientific advances in numerous disciplines have revealed misconceptions in previous assumptions about the structure and function of riverine and floodplain ecosystems. They have also highlighted the many direct and indirect adverse consequences of human interventions in these systems for flood management, water supply, urban and agricultural land use, and other purposes. Among these consequences is the precipitous decline in the number and extent of many aquatic and terrestrial species.

The scientific community recognizes the ecological benefits of flooding and the importance of maintaining the connection between the river and its floodplain. At the same time, present public attitudes show an increased awareness of the vital goods and services, including flood protection, provided by healthy riverine and floodplain ecosystems. ●

ACCOMPLISHMENTS OF PHASE I

Post Flood Assessment

**Initiated Public Outreach and
Agency Coordination
Programs**

Identified Existing Problems

**Established Framework
for the Study**

**Prepared for
the Analytical Challenge**

**Developed an
Implementation Strategy**

**Identified Phase II
Study Tasks**

Post Flood Assessment

- Four Flood Events - 1983, 1986, 1995, and 1997
- Identified damages sustained and prevented
- Developed an economic depth-damage relationship for flood damages
- Assessed existing flood management systems

Initiated Public Outreach and Agency Coordination Programs

- Established communication strategy emphasizing focus groups
- Involved agencies and stakeholders in problem and potential solution identification
- Identified opportunities for coordination with existing programs

Identified Existing Problems

- Flooding problems
- Environmental problems related to flooding and flood management
- Policy issues, institutional barriers, and potential changes

Established Framework for the Study

- Established study objectives
- Developed a framework for formulating the comprehensive master plans

Prepared for the Analytical Challenge

- Developed hydrologic and hydraulic models for system-wide evaluations
- Conducted extensive topographic and bathymetric surveys for both river basins
- Developed ecosystem function model
- Assembled vast GIS to support study and other projects

Developed an Implementation Strategy

- Established process to spin-off projects to existing authorities
- Identified process for early implementation
- Defined full program implementation requirements

Identified Phase II Study Tasks

- Expanded public involvement
- Plan formulation and evaluation
- Environmental, socioeconomic, engineering, real estate analyses
- Programmatic NEPA and CEQA documents

Post Flood Assessment

A Post Flood Assessment was completed in accordance with Congressional Authorization as part of the Sacramento and San Joaquin River Basins Comprehensive Study.

The Post Flood Assessment focuses on the impact of major floods in the Sacramento and San Joaquin River basins during 1983, 1986, 1995, and 1997. It also describes the development of flood protection in the Central Valley during the past 150 years. This includes descriptions of major flood events prior to 1983 and a summary of flood protection facilities and their operating objectives and constraints. The extent of flooding for each of the four years was identified from aerial photography and is included as a part of the GIS for the Comprehensive Study.

For each of the four flood events evaluated, the Post Flood Assessment describes prestorm and storm conditions, system problems (such as reservoir management concerns and levee failures); corrective actions taken; economic damages sustained due to flooding; and economic damages prevented through the operation of the flood management systems. The report also identifies problems in the existing flood management systems, and identifies the populations and value of property at risk of flooding.

Congressional Authorization:

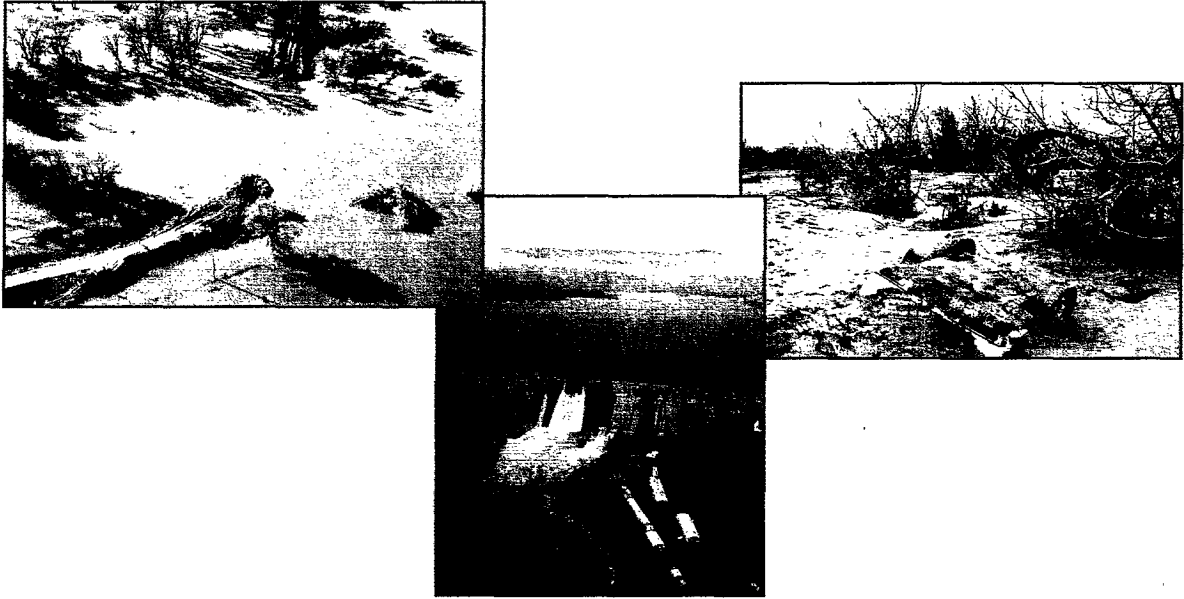
"... conduct a comprehensive assessment of the entire flood control system . . . These comprehensive investigations will include: (1) preparation of a comprehensive post-flood assessment for the California Central Valley (Sacramento River Basin and San Joaquin River Basin)..."

DAMAGES SUSTAINED AND PREVENTED IN RECENT FLOODS

(values in \$ millions)

Event (Year)	Damages Sustained			Damages Prevented		
	Sacramento River Basin	San Joaquin River Basin	Total	Sacramento River Basin	San Joaquin River Basin	Total
1983	\$91	\$324	\$415	\$2,833	\$247	\$3,080
1986	\$172	\$15	\$187	\$9,881	\$324	\$10,205
1995	\$305	\$193	\$498	\$3,541	\$156	\$3,697
1997	\$301	\$223	\$524	\$20,417	\$811	\$21,228

Note: Values represent conditions and price levels for the year of the event.



The Post Flood Assessment found that the existing flood management systems prevented over \$38 billion in potential damages during the four recent flood events. However, the systems were clearly overtaxed as evidenced by numerous failures resulting in damages exceeding \$1.6 billion.

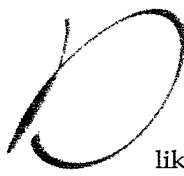
Damage Survey

As part of the Post Flood Assessment, an economic study was completed to develop site specific relationships between depth of water and economic damages. The study was based on surveys of 260 residences in the town of Arboga, near the Feather River, that were affected by extensive flooding in January 1997. Over 700 homes in Arboga area experienced a wide range of flooding depths, ranging from very little water to depths in excess of 20 feet with structures totally covered.

Results from this study will be used to estimate damages to other single story homes in California's Central Valley. In addition, the results of this study will be combined with results of studies in other areas of the country to improve estimates of nonphysical costs and the effects of duration, velocity, sediment, and lead-time on flood damage. ♦



Public Outreach

uring Phase I of the Comprehensive Study, a public outreach program was developed and initiated to communicate progress and provide a forum for stakeholder involvement. The public outreach program concentrates on geographic regions and stakeholders most likely to be interested in and affected by the study. A wide array of communication media were developed to assure that timely information reaches potentially interested parties. News releases and newsletters were used to report progress on the Comprehensive Study and notify interested parties of public involvement opportunities. Where appropriate, stakeholders were interviewed to obtain information for potential use in the study.

Public involvement during Phase I included several discussion groups, which were formed to encourage public participation in the identification of problems. The groups provided a forum for diverse interests to share their perceptions of the problems and for agency representatives to achieve a better understanding of public and other agencies concerns.

Technical support groups...

...identified known problems and potential solutions



Policy focus groups...

...identified policy issues and needs for policy changes



Local support groups...

...identified local concerns regarding potential solutions

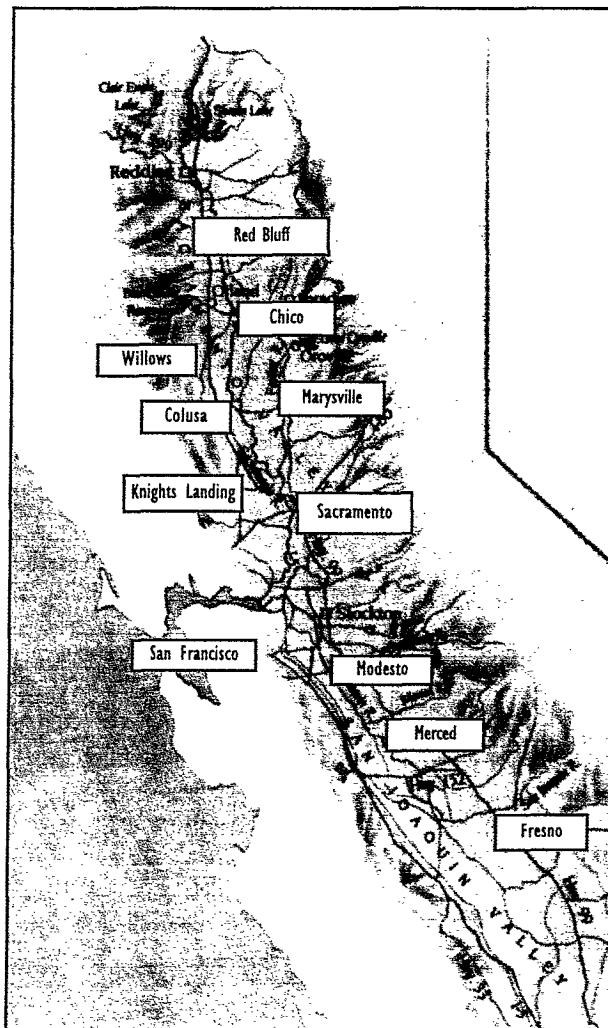
Early in Phase I, **Technical support groups** met to identify known problems with the existing systems. These groups included participating agencies, local governments, organizations, and individuals throughout the Central Valley.

Between June and September 1998, The Reclamation Board and the Corps held four **Policy focus group** meetings to address issues that affect flood management and ecosystem restoration. The group identified policy and institutional barriers that

affect flood damage reduction, associated land use planning, and environmental restoration and identified potential changes to existing policies based on the issue statements.

In November 1998, eleven **Local support group** meetings were held at locations throughout the Sacramento and San Joaquin River basins to further define problems and identify potential opportunities for solutions. These meetings were closely coordinated with local California Department of Water Resources offices, who have historically worked with local stakeholders on water management and flood protection issues. ♦

LOCAL SUPPORT GROUP MEETINGS



Agency Coordination

THE EXECUTIVE COMMITTEE

U.S. Army Corps of Engineers

The Reclamation Board

San Francisco

State of California

Participating Agencies

Federal

Fish and Wildlife Service

Forest Service

Environmental Protection Agency

Federal Emergency Management Agency

Bureau of Land Management

Geological Survey

National Marine Fisheries Service

Natural Resources Conservation Service

Bureau of Reclamation

State

Department of Fish and Game

Water Resources Control Board

Department of Water Resources

Department of Parks and Recreation

Department of Boating and Waterways

State Lands Commission

Office of Emergency Services

Department of Food and Agriculture

CALFED Bay-Delta Program
(Federal/State)

The Comprehensive Study is being developed at a time when several other major programs are considering ecosystem restoration in the Central Valley. Inter-agency cooperation and public involvement will assure that solutions are well-coordinated and opportunities for complimentary benefits are exploited.

An Executive Committee, comprised of numerous State and Federal agencies, provides project direction, lends resources for the study, assists in resolving emerging policy issues, and ensures that study results and policies are consistent and coordinated with other related programs.

COORDINATION WITH OTHER PROGRAMS

The Federal and State governments are jointly involved in several major programs that address ecosystem restoration in the Central Valley. The Comprehensive Study's joint objectives of flood damage reduction and ecosystem restoration necessitate close coordination with other programs. Often, measures for flood damage reduction, improved water management, and ecosystem restoration can be combined to enhance their effectiveness and produce complimentary benefits.

Through the Executive Committee and other outreach efforts, the Comprehensive Study will identify opportunities where flood damage reduction and ecosystem restoration measures could be combined or expanded with other programs to help accomplish mutual objectives. While many programs are being examined, prime examples of coordination opportunities with major ongoing programs are described below.

CALFED Bay-Delta Program

The CALFED Bay-Delta Program and Ecosystem Restoration Program Plan, established in May 1995, is a cooperative effort by State and Federal agencies to develop long-term measures to resolve problems affecting the San Francisco Bay / Sacramento-San Joaquin Delta estuary. CALFED objectives include ecosystem restoration, and improvements to water quality, water supply reliability, and Delta levee reliability.

CALFED's geographic focus for improvement is the Bay-Delta estuary, although potential solutions may be implemented throughout the Central Valley and beyond. The Comprehensive Study is closely coordinated with CALFED to identify, refine, and potentially expand restoration actions that could be integrated with flood damage reduction measures or other ecosystem restoration measures to help achieve the objectives of both programs.

Coordination with Other Programs (cont.)

Central Valley Project Improvement Act

The 1992 Central Valley Project Improvement Act (CVPIA) authorized the Secretary of the Interior to modify Central Valley Project operations and implement actions to restore and protect aquatic and waterfowl habitat in the Central Valley. Restoration actions authorized by the CVPIA include reoperation of CVP facilities, reallocation of water supplies for ecosystem purposes, in-stream restoration actions, and acquisition of water for improved aquatic habitat. The Comprehensive Study is closely coordinated with the U.S. Fish and Wildlife Service and the Bureau of Reclamation to identify CVPIA actions that could be integrated with flood damage reduction or ecosystem restoration measures to help achieve the objectives of both programs.

Upper Sacramento River Fisheries and Riparian Habitat Management Plan

In 1989, the State Resources Agency adopted a plan prepared by the Upper Sacramento River Fisheries and Riparian Habitat Advisory Council that describes actions to protect, restore and enhance fish and riparian habitat and associated wildlife in the upper Sacramento River. The advisory council, established in 1986 by State Senate Bill 1086, prepared the "Draft Sacramento River Conservation Handbook." A memorandum of agreement is under review by several agencies who through this agreement will support the outlined riparian habitat strategy.

San Joaquin River Management Program

The State of California in 1990 established a program to solve water-use problems within the San Joaquin River system. In 1995, the California Resources Agency adopted a plan that identified measures to improve water quality, water supply, flood protection, recreation, fisheries, and wildlife habitat in the San Joaquin River Watershed. The plan, prepared by an Advisory Council representing Federal, State, and local agencies and private interests, recommended 47 projects, 24 studies, and 3 acquisition goals. Many of the measures identified in this plan will be reviewed during Phase II of the Comprehensive Study. ♠

The Comprehensive Study is taking full advantage of the expertise and capabilities of numerous participating agencies.

Identified Problems



problems with the existing flood management systems, both **flood problems** and **related environmental problems**, were identified by the study team through technical support group meetings.

Flood Problems



- The flood management systems, designed early in this century, do not now have the capacity to convey peak floodflows experienced in the past decade.
- For many parts of the systems, the level of flood protection is not known and may not correlate to the value of property at risk of flooding.
- Levee structural integrity is not reliable in some parts of the systems.
- The cost to maintain the systems is extremely high because of erosive floodflows or sedimentation.
- No public or private entity has responsibility for maintaining flow-carrying capacity of the San Joaquin River channel from the Merced River downstream to the Delta.
- The current operation plans for existing reservoirs, lack of systems operations models, and the need for additional storage, preclude optimal use of storage in the flood management systems.

Environmental Problems Related to Flooding and Flood Management



- Confining floodflows in reservoirs and between levees has caused the loss of natural hydrologic and geomorphic processes. Habitat for fish and wildlife has been lost or severely degraded as a result of the loss of natural processes.
- Mitigating for loss of habitat related to bank protection has in the past been inadequate and/or unsuccessful due to constraints related to funding, compensation to neighboring landowners, potential impacts to infrastructure, and lack of suitable sites.
- Species numbers and community diversity are being lost because the quantity and diversity of remaining riparian, wetland, and shaded riverine habitats are insufficient.
- Restoration of habitats and critical ecosystems has been limited by the lack of natural stream processes, and adequate space for habitat, and some levee maintenance policies.
- Nonnative plants and animals threaten the survival of native species and can decrease floodway capacity.
- Reservoir releases to provide flood storage possibly could be modified to benefit downstream fisheries without impacting flood storage. ♦

Objectives, Principles, & Considerations



During Phase I, planning objectives, principles, and considerations were developed to guide the Comprehensive Study. Planning objectives recognize the dual goals of the Comprehensive Study as well as potential policy issues and institutional barriers. The Comprehensive Study will be guided by the principles that significant progress is needed toward both flood damage reduction and ecosystem restoration, and that measures must be commonly acceptable, legally feasible, and implementable. Through public outreach and stakeholder involvement, it was acknowledged that political, economic, environmental, and public factors that historically restrict the planning, operation, and maintenance of flood management systems must be addressed.

Improve flood risk management throughout the systems

- Identify existing flood protection levels for the system
- Avoid or reduce potential flood damages in the future through flood risk education
- Improve reliability, conveyance capacity, and use of reservoir storage to reduce risk
- Minimize operation and maintenance costs of the flood management system
- Improve system-wide floodplain management among local, State, and Federal entities

Integrate ecosystem protection and restoration with flood damage reduction measures

- Promote natural processes
- Increase and improve riparian, floodplain, and riverine habitat
- Promote recovery of threatened and endangered species and the stability of native species
- Preserve agricultural productivity while promoting the ecological value of agricultural land

Resolve policy issues and address limiting institutional procedures

- Develop tools to analyze the hydrologic, hydraulic, geomorphic, and biologic processes of the flood management systems
- Improve flood damage reduction management and streamline procedures to obtain permits to minimize and resolve conflicts
- Develop a process to identify multiple-objective solutions that are likely to be accepted by all concerned and can be implemented in a timely manner
- Develop a process for flood management system damage recovery that identifies short-term measures that will protect flooded or damaged areas from further damage, but will allow serious consideration of short-term and longer-term actions that integrate floodplain and ecosystem restoration. ●

Identified Measures

Measures for flood damage reduction and ecosystem restoration were identified from many sources, however the chief source of ecosystem restoration measures was CALFED's Ecosystem Restoration Program Plan. Measure types were further defined in meetings with Focus Groups, the Local Support Groups, and the Executive Committee.

Two types of measures were defined; those that primarily address flood damage reduction and those for ecosystem restoration. These measures are not always mutually exclusive, as many have the potential to help meet both goals, which is the ultimate objective of the master plans to be developed in Phase II.

Flood Damage Reduction Measures

Measures Affecting Flood Flow Regime

- Create or modify existing reservoir storage and/or releases
- Create or modify transient storage in flood basins
- Modify existing water control plans

Measures Affecting System Capacity

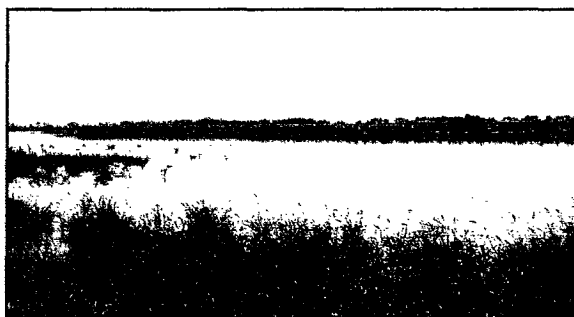
- Backup levee
- Setback levee
- Reconstruct channel
- Raise levee
- Improve or create bypass system
- Create meanderbelt
- Manage vegetation/substrate within existing floodway

Measures Affecting System Reliability

- Protect streambank
- Strengthen, raise, or repair levee

Measures Affecting Management of the Floodplain

- Modify existing buildings to reduce future damage
- Discourage future development in floodplains
- Redirect incompatible development out of floodway/floodplain
- Require flood insurance

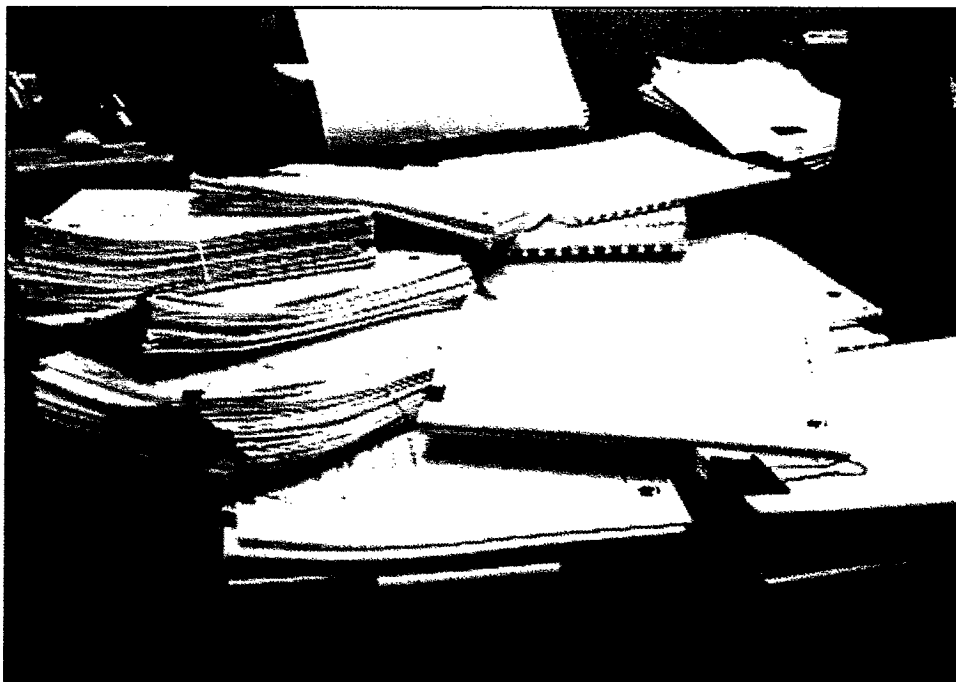


Ecosystem Restoration Measures

- Reforest Floodplain Corridors
- Protect Existing Natural Physical Processes
- Re-establish Suitable Hydrologic Regime to Restore Natural Physical Processes
- Remove Bank Protection to Restore Natural Processes
- Allow Riparian Forest to Reach Maturity
- Restore Oxbows -- grade and plant abandoned oxbows
- Hardpoint Bank Protection -- protect pumps, diversions, etc. locally (e.g., with mini spur-dikes) rather than continuous revetment
- Restore and Reforest High Terraces and Berms
- Raise Bypass Levees to Allow Habitat Development
- Raise Mainstem Levees to Allow Habitat Development
- Allow Habitat Development within Off-Stream Storage Areas
- Create Habitat Node(s) ♠



Policy Issues & Institutional Barriers to Overcome



Ecosystem Restoration, Flood Damage Reduction, and the Regulatory Process

- Agency exemptions from compliance reduces authority of other agencies
- Permit compliance requirements are time consuming and costly
- Conflicts arise between ecosystem restoration and flood management objectives
- It is difficult to acquire land to increase capacity of floodplains and floodways
- Setback levees could be incompatible with agricultural land uses or sever riparian rights
- Ecosystem restoration opportunities may conflict with raising, strengthening, and protecting levees
- Bank protection projects lack funding
- Focus on traditional alternatives has caused environmental impacts
- Focus on nontraditional alternatives may overlook environmental benefits of dams and reservoirs
- Reoperation of existing facilities is limited by other beneficial uses, such as downstream water supply, hydroelectric energy production, fisheries, and habitat values

Flood Risk and Hydraulic Effects

- Floodplains are not consistently delineated, making land use and flood planning difficult
- Some floodplain designations are unreliable
- Flood planning needs to be integrated with land use planning and local decision making
- Reimbursement policies provide disincentive for alternative flood damage reduction approaches
- No consistent policies exist to assess hydraulic impacts and mitigation

Limitations with Federal and State planning and project development

- Multiple partnering of multi-objective projects is difficult
- Projects do not always address regional problems - approach is local, or piecemeal
- Emphasis on National Economic Development can overlook the benefits of integrating ecosystem restoration
- No clear methodology exists to formulate plans that provide different types of outputs
- Lack of policy on reimbursements to local interests for locally constructed projects
- The Reclamation Board has no authority or mission to participate in ecosystem restoration projects that are unrelated to Federal flood damage reduction facilities

Plan Formulation Framework

The Comprehensive Study recognizes that many flood damage reduction measures lend themselves to incorporation of specified ecosystem restoration features, and that many restoration measures can be configured to help reduce flood damages. The goal of the Study is to provide opportunities for multi-purpose solutions that address both flood damage reduction and ecosystem restoration.

Based on an initial assessment of the system, discussions with local agencies, and the complexity of developing an overall plan, the proposed framework includes three system-evaluation steps. Each step will help identify system limitations, hydraulic constraints, and desired system performance. Because several regional programs specifically address ecosystem problems in the valleys, this framework will focus on identifying target levels for flood damage reduction. The evaluation approach considers goals of on-going restoration programs, which will be incorporated at each formulation step.

The goal of the Study is to provide opportunities for multi-purpose solutions that address both flood damage reduction and ecosystem restoration.

Formulation Step 1

Evaluate Originally Intended Flood Management Function

The goal for this step will not necessarily be to examine the original project configuration and/or design, but to examine the broad intended flood management purpose of the systems and identify ways to meet that purpose. The originally intended flood management purpose will be identified for each element of the systems. Design capacities and system functions will be compared with the baseline condition and differences will be identified. Based on these findings, measures that include both structural and nonstructural components will be developed for further analysis.

Formulation Step 2

Identify System Constraints

Beyond the analysis in Step 1, this step will identify limiting factors in the flood management systems. Recent hydrologic data suggest that restoring the original system function may not adequately reduce the risk of large flood damages. Some reasonable modifications to existing features may significantly improve the flood management capability. Based on continued modeling and evaluation, a plan that includes both structural and nonstructural components will be developed and possibly combined with measures identified in Step 1.

Formulation Step 3

Address Residual Flood Risk

Given changes in land use, hydrology, and project development, different sub-reaches with similar land uses and infrastructures may be afforded very different levels of flood protection. Based heavily on public and stakeholder input, Step 3 will identify appropriate levels of flood risk by land use and infrastructure within each sub-reach. Based on continued stakeholder input and system modeling, measures that include both structural and nonstructural components will be developed consistent with the identified protection levels. ♠

Implementation Strategy

The final Comprehensive Study report will be a programmatic document. It will include a recommendation for programmatic authorization of the master plans similar to the Critical Projects Program authorized in Section 528(b) of WRDA '96, and will be consistent with fiscal resources and other constraints. Implementing the master plans will be staged. One important consideration in project staging is to maintain the integrity of the flood management systems and the participation of local sponsors throughout the implementation. The need to reduce flood damages and restore ecosystems is immediate. Early in the process, projects will be recommended for immediate authorization and/or implementation.

In view of the tremendous scope and the relatively short time frame, not all elements of the master plans will be fully developed and coordinated by the end of Phase II. The more complex elements of the master plans will be developed and prioritized for implementation under a programmatic process similar to the one outlined in Section 528(b) of WRDA '96.

Spin-Off Projects

Because of the large geographic scope of the Comprehensive Study, potentially feasible projects have been, and will continue to be, identified throughout the planning process. These potential projects may match the goals and objectives of the study, may meet the programmatic definition of water resource problems, and may have support for immediate implementation by Federal and non-Federal sponsors. Some of these potential projects may also match the goals and objectives of other State or Federal programs as well as meet the objectives set by this study. Procedures have been developed during this study to identify projects that may "spin-off" into another applicable program for immediate implementation by the Corps, State, or other entity.

Projects may also qualify as spin-offs if they could be more efficiently and effectively implemented through a different program. Spin-off projects could include projects for which expertise is housed in an agency or organization other than the Corps or The Reclamation Board and Department of Water Resources.

Three spinoff projects were identified in Phase I and have been advanced on to project-specific evaluation and planning processes. The Comprehensive Study will continue to monitor the progress of these projects and will incorporate their components into the ultimate plan. Throughout the Comprehensive Study process, the study team will continue to identify other potential spin-off projects and provide support for their implementation.

Early Implementation Projects

Early implementation projects comprise the second implementation stage of the master plans to reduce flood damages and integrate ecosystem restoration for the Sacramento and San Joaquin River basins. Early implementation projects will be identified and developed to feasibility level detail during Phase II of the Comprehensive Study. The study team will encourage the public, stakeholders, flood management agencies, participants in other projects, and other government entities to propose early implementation projects. These projects will be clearly identified in the Comprehensive Study's final report.

Early implementation of critical projects will help reduce the risk from future flood disasters while the master plans are being developed.

Early implementation projects will be identified, developed, and recommended for Congressional authorization and implementation in the final report. Developing and implementing projects that meet multiple objectives of the related, ongoing programs in the study area may require Federal authorization of innovative funding arrangements because of multi-agency involvement.

EARLY IMPLEMENTATION PROJECTS

Provide significant flood damage reduction and ecosystem restoration benefits

Do not preclude other options in the flood management system

Have a broad support among agencies and stakeholders

Have a sponsor willing and financially able to participate

Full Plan Implementation

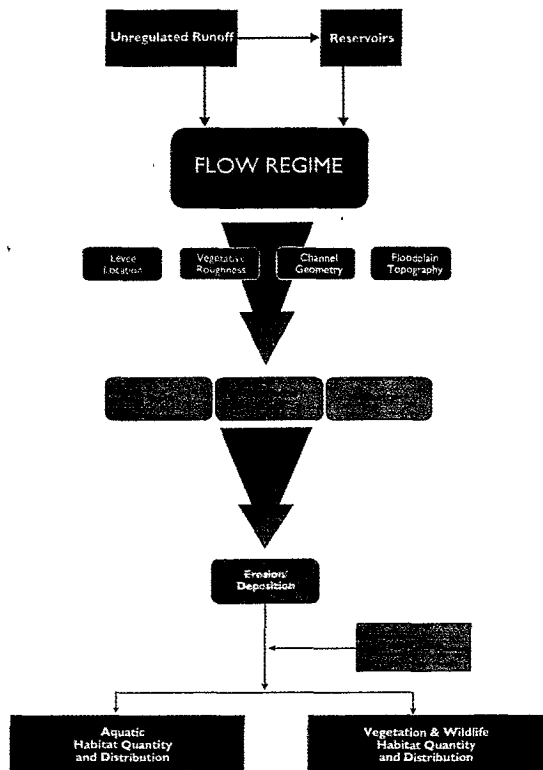
The final report and supporting environmental documentation will be programmatic in nature, and it is expected to include a recommendation for programmatic authorization of the master plans. The master plans will be a guide for future project development and for decisions about emergency response activities. The master plans will ensure that site-specific projects and actions are fully coordinated and integrated. ♦

Analytical Tools for the Comprehensive Study

A set of computer-based analytical tools was developed during Phase I of the Comprehensive Study. Work focused on four major components critical to evaluate flood management and ecosystem conditions. Through this development, the longstanding need for mathematical and conceptual models to simulate hydrologic, hydraulic, and ecosystem functions was fulfilled.

Hydrologic And Hydraulic Models

The authorization for the Comprehensive Study directed the development of hydrologic and hydraulic models for both river basins that will allow systematic evaluation. These first ever models incorporate historic rainfall-runoff, reservoir operations, and flow along the major river systems to effectively evaluate the hydraulic performance of the entire flood management systems. The models can be used to evaluate the performance of the current systems or modified systems, under a wide range of hydrologic conditions.



Ecosystem Functions Model Conceptual Design

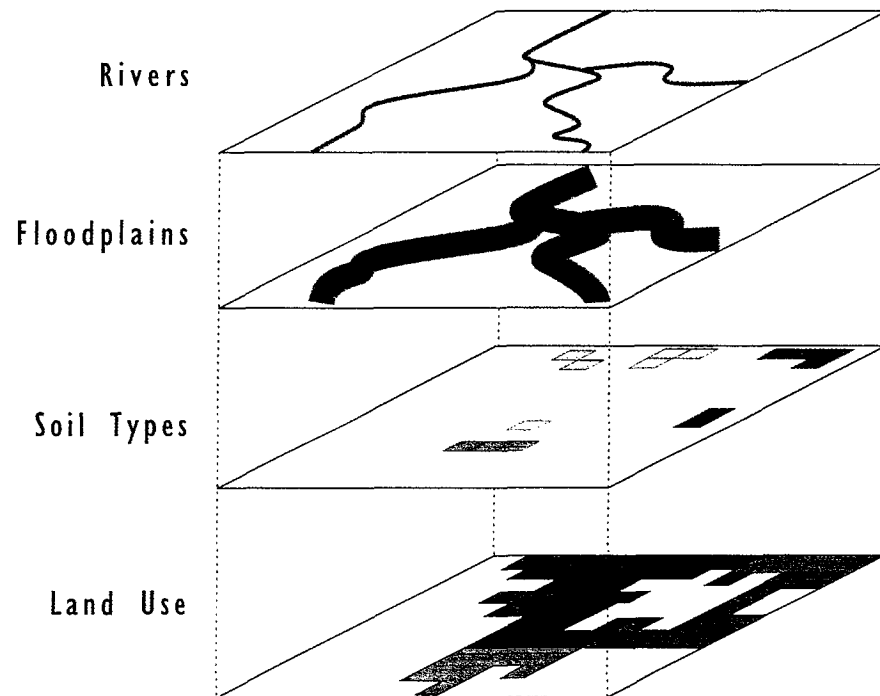
A conceptual design for an Ecosystem Functions Model (EFM) was prepared during Phase I. Once fully developed, the model will be used to assist in the design of potential measures, indicate their expected impacts, and evaluate their effectiveness. The EFM will focus on physical processes that drive biological responses. The model will combine streamflow information from hydrologic and hydraulic models with biological and physical information to determine the effects of measures on the ecosystem. The amount, distribution, and character of aquatic, wetland, and riparian habitats under existing conditions will be compared to future without project conditions and alternatives.

Topographic Data

A major data collection effort during Phase I focused on development of topographic and bathymetric data in the Sacramento and San Joaquin River basins. These data describe the contour of existing land forms and are integral to the hydraulic analysis and evaluation of environmental effects of alternative plans. Existing data for the Sacramento River basin were updated and new data were developed for the San Joaquin River basin where previous data did not exist. When complete, topographic data will be loaded to the GIS for use in hydraulic and ecosystem analyses.

Geographic Information System

During Phase I, GIS data were obtained from multiple State and Federal sources to take maximum advantage of existing data. The GIS has been used to prepare base maps and figures. In future studies the GIS will be used to evaluate the measures, and perform mapping analysis associated with the model for ecosystems functions. ♠



Outlook for Phase II



During Phase II, the Comprehensive Study will continue and expand the public outreach program • complete model development • formulate and evaluate alternative flood management and ecosystem restoration alternatives • develop programmatic environmental documentation • and identify additional policy and legislative requirements to support implementation.

Expand Public and Stakeholder Involvement

During Phase II, the public outreach program will be used to obtain input and report findings on the Comprehensive Study and integrate the public and stakeholders into the formulation and analysis of alternatives.

Expand Public and Stakeholder Involvement

Identify problem areas and linkages with other resource management programs

Establish refined planning objectives

Gain acceptance of potential flood damage reduction measures

Understand and accept specific management measures for specific failure points

Integrate ecosystem restoration benefits systemwide

Develop desired flood protection levels

Plan Formulation and Evaluation

During Phase II, the hydrologic/hydraulic, ecosystem functions, and flood damage assessment models, as well as environmental, economic, and engineering design technical studies, will be used to evaluate and combine measures to prepare the master plans for the two basins.

The hydrologic and hydraulic models will be completed and calibrated. With these models, overbank floodflows will be simulated to determine the effectiveness of the flood management system to convey large flows and identify areas where the system is inefficient. Frequency curves for the main stems of the Sacramento and San Joaquin Rivers will be updated and revised and sedimentation models will be used to determine reaches of aggradation and degradation.

The Ecosystem Functions Model will be fully developed, tested on one to three pilot reaches, further refined and calibrated, and used throughout the remainder of the study to evaluate potential effects of various measures. The GIS database, a key component of the ecosystem functions model, will be critical in forecasting output from the proposed ecosystem restoration and will be used to identify impacts to existing resources.

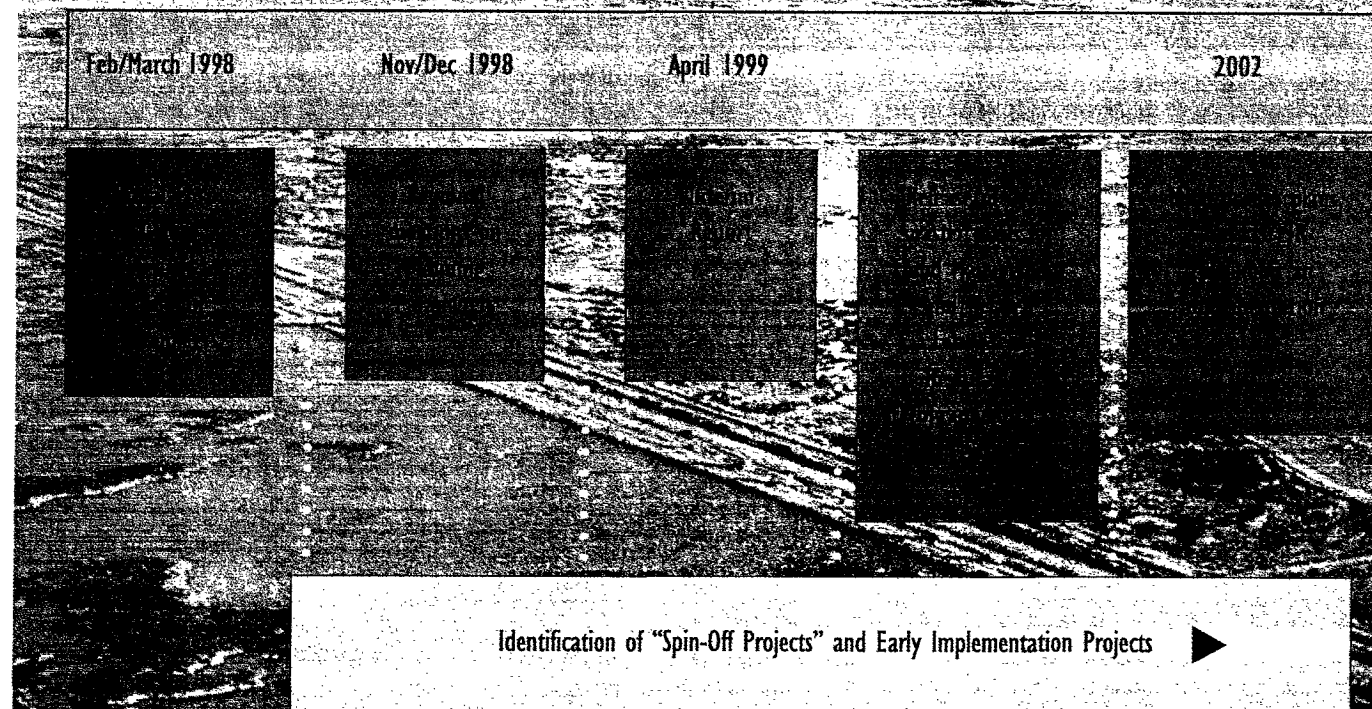
Programmatic Environmental Documentation

A programmatic environmental impact statement/environmental impact report (EIS/EIR) will be prepared in Phase II. The programmatic EIS/EIR will evaluate overall potential environmental effects of the measures and plans for flood damage reduction and ecosystem restoration along the Sacramento and San Joaquin Rivers. Subsequent documents on specific actions then only need to address site-specific issues. Programmatic documents recently prepared by CALFED, the U.S. Fish and Wildlife Service, and the U.S. Bureau of Reclamation may have already addressed some measures and actions. ♦

The Phase II public involvement program will support development of NEPA and CEQA environmental documentation on the Comprehensive Study.

Study Schedule

The Comprehensive Study was approved in October 1997 and initiated with the signing of the Feasibility Cost Sharing Agreement in February 1998. This Interim Report concludes Phase I. The Phase II report will be completed in 2002. ♠





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Sacramento and San Joaquin River Basins

Comprehensive Study